## Tissue repairs using a biodegradeable laser-activated solid protein solder

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Laser repairs to tissues have traditionally suffered from the problems of insufficient strength of the repairs, particularly for high-pressure fluid-carrying tubes such as arteries, and thermal damage to surrounding tissues hindering tissue recovery. The protein solder helps to strengthen the join by adding material to the tissue junction. In addition, the protein solder protects underlying tissue from damage due to excess laser-induced heat deposited in the tissue. Our protein solder consists of a high concentration solution of bovine serum albumin, mixed with indocyanine green dye to enhance the solder's absorption of the 800-nm diode laser light used to activate the solder.[1] The solder is formed into hollow tubes and pre-heat treated to enhance its stability and strength during and immediately after surgery. The fold-and-bond surgical technique we have used to repair blood vessels with the protein solder is based on a technique reported early this century.[2]

A total of 90 rats were divided into two groups. In group one, the repairs were performed using conventional microsuturing techniques, and in group two, the repairs were performed using our new laser welding technique. In addition, subgroups of animals from each group were evaluated at times of 10 min, 1 hour, 1 day, 1 week and 6 weeks, after surgery. The time the aorta was clamped was noted for each procedure and the results analysed statistically. Subsequently, after the selected evaluation period, each repair was tested for patency and mechanical strength. Furthermore, three animals from each subgroup were sacrificed to allow histological examination of the surgical repair site.

All repairs were patent at the time of evaluation. The mean clamp time of all repairs performed by microsuturing was 20.6 minutes, compared to the mean clamp time of all laser soldered repairs of 7.2 minutes ($p < 0.0001$). The strain measurements revealed a stronger mechanical bond of the sutured repair in the initial phase, but after six weeks, the mechanical resistance was comparable for both techniques. Histological evaluations indicated that the solder was resorbed by the body after 6 weeks, and that negligible thermal damage occurred to surrounding tissue.

In conclusion, our new technique using a resorbable protein as a solder activated by a diode laser provides a reliable safe rapid arterial repair, which could be performed faster than conventional suturing after a short learning curve.

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